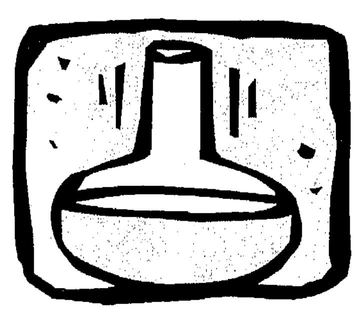
11. TOXICITY OF UNKNOWN ORIGIN



11. Toxicity of Unknown Origin

11.1 Summary

All elements causing toxicity in the Sacramento and San Joaquin River watersheds and in the Delta have not been identified in current evaluations. Without identification, corrective actions cannot be taken to stop toxicity. A program to identify toxicants and their individual environmental effects is presented here.

11.2 Problem Statement

In approximately half of the toxicity tests conducted in the Sacramento River watershed, the toxicity detected in test species has not been linked to specific chemicals. This is also true for approximately 30% of the toxic samples collected in the Delta and the San Joaquin River watershed. A toxic must be identified before actions can be proposed to control its toxic effects.

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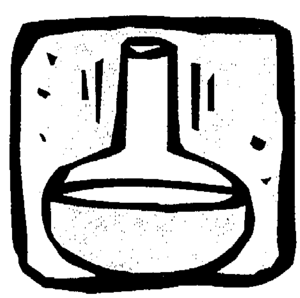
11.3 Objective

The objective is to further identify parameters of concern in the water and sediment in the Delta, Bay, Sacramento River, and San Joaquin River Regions and to implement actions in order to reduce the toxicity of identified parameters to aquatic organisms. The methodology used to control unknown toxicity is a staged procedure.



11.4 Problem Description

11.4.1 Background

Toxicity is suggested when performance of a test species is statistically different than its performance in a clean laboratory control.

A toxicity test is a laboratory procedure to determine the toxicity of a water or sediment sample using a test species. Protocols have been developed and promulgated by the EPA for both fresh- and salt-water species (fish, invertebrates, and algae) in both water and sediment samples. In a toxicity test, field samples are collected and brought back to the laboratory, and the test species is introduced to the field sample. Survival or other end points (such as measures of growth or reproduction) are monitored for the duration of the test. Essentially, the tests ask the test species if they can live, grow, or reproduce in a site sample. Toxicity is suggested when performance of a test species is statistically different than its performance in a clean laboratory control. The tests are one way to assess compliance with the narrative standard of "no toxics in toxic amounts," which is part of each RWQCB's WQCP (Basin Plan). The tests indicate whether the test species survive (or perform less well) in site water. However, the test does not indicate why toxicity occurred. Chemical monitoring and a toxicity identification evaluation (TIE) are used to determine the cause of toxicity. The TIE is a set of procedures designed to identify the specific causative agents responsible for the observed toxicity. An unknown toxicity or a "toxicity of unknown origin" refers to the situation where toxicity has been detected but a TIE either has not been performed or has not successfully identified a toxicant. An unknown toxicity suggests that a water quality problem exists for aquatic organisms and also indicates a violation of the narrative standard; therefore, it is a regulatory problem. To eliminate the toxicity from the location where sampling occurred, it is useful to know the specific chemical cause and the source(s). Once this information has been determined, MPs can be implemented to eliminate the observed toxicity.

11.4.2 Toxicity Found

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Since 1986, the CVRWQCB and DFG have tested the surface waters of the Central Valley for toxicity. Sediment testing also has occurred but on a more limited basis. The fresh water aquatic test species recommended by the EPA are the fathead minnow, a cladoceran (*Ceriodaphnia dubia*), and a unicellular green algae (*Selenastrum capricornutum*). In addition to testing with these species, limited testing has been performed using indigenous species, including striped bass, rainbow trout, and two invertebrates (*Neomysis* and *Brachionus*). The fresh-water species used in bulk sediment toxicity testing are an amphipod (*Hyallella azteca*) and a midge (*Chironomus*). Tests on the pore space water within sediments frequently are performed using *Ceriodaphnia*. The San Francisco Estuary Institute's RMP performs toxicity tests on both water-column and sediment samples using marine species.

In approximately half of the toxicity tests conducted in the Sacramento River watershed, the toxicity detected with these test species has not been linked to specific chemicals. This is also true for approximately 30% of the toxic samples collected in the Delta and in the San Joaquin River watershed. The entire Delta, reaches of both the Sacramento and San Joaquin Rivers, and several tributaries are listed under the CWA Section 303(d) for unknown toxicity.

The San Francisco Estuary RMP for San Francisco Bay also has conducted toxicity testing in the Delta and Bay. In brackish and salt water, a number of test species can be used. Unknown toxicity has been detected using *Mysidopsis bahia* (mysid shrimp). In sediment bioassays, significant amounts of unknown toxicity have been detected using *Eohaustorius* and *Mytilus*.

Unknown toxicity is of significant concern because it indicates that agents exist that are bioavailable and causing toxicity that remains to be identified. Unknown toxicity is also an issue for the Sacramento River watershed and the Delta because unidentified toxicants lead to the noncompliance of these water bodies with the narrative toxicity objective of the Basin Plan. A number of stakeholders are interested in resolving the issue of unknown toxicity, including regulatory agencies, point and non-point source dischargers, environmental advocates, farmers, miners, water supply agencies, and the general public.

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11.4.3 Known Data Gaps

By definition, the problem of unknown toxicity is the existence of data gaps. Where toxicity has been detected, several other factors need to be determined before control strategies can be implemented. The specific contaminates must be identified. Once identified, the duration, magnitude, and frequency of pollution needs to be determined. Sources and the practices or actions that allow the toxicants to enter receiving waters also must be identified.

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Knowledge is limited about the ecological impacts of the unknown toxicity that is identified with selected bioassay species. Some bioassay testing has been done with native species. It has been argued that use of native species is the appropriate toxicity test. It is also realized that thousands of native species exist; in different test conditions, one species cannot approximate the response of the masses.

Toxicity testing has not been conducted throughout the watershed. To date, testing has focused on the major tributaries and downstream of the major reservoirs.

The toxicity testing conducted by the RMP has used marine species in fresh-water samples. Once the cause of toxicity is identified, the impact of salinity must be evaluated.

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11.5 APPROACH TO SOLUTION

The following approaches are proposed:

- Determine the extent of toxicity in water and sediments.
- Identify toxicants.
- Determine the sources of toxicants.
- Develop techniques and protocols in toxicity bioassays for indigenous species.
- Evaluate source control measures.

11.5.1 Priority Actions

Ideally, when toxicity is detected, a TIE is performed and a causative agent is identified. Once a chemical is identified, it can be monitored in the field to identify its source and to characterize its spatial and temporal distribution. This information, along with concentration data, can be compared to values in the toxicological literature to provide a rough estimate of ecological risk. This is the process that was used for several of the chemicals that currently are included in CALFED's list of constituents of concern (for example, diazinon and chlorpyrifos).

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CALFED already has approved funding to follow up on the unknown toxicity observed with fathead minnows and *Selanustrum* (algae). Activities to address these toxicity events follow the process outlined here.

Determining the chemical(s) responsible for toxicity requires using all the information available. Work would occur simultaneously in all of the following areas:

- Conduct a TIE.
  - Phase I. Determine the general class or characteristics of the toxicant (Is it a metal or an organic compound? Is it volatile, filterable, or sublatable [neutralized]?)
  - Phase II. Determine the specific chemical(s)
  - Phase III. Confirm the chemical(s)
- Determine the spatial and temporal variability of toxicity.
- Determine the source of toxicity.
- Examine land use in the watershed to determine potential contaminants. For example, for agricultural land use, look at cropping patterns and pesticide/fertilizer application patterns. Work with the county agricultural commissioner, DPR, farm advisors, pesticide applicators, and growers.
- Consider species sensitivity. Review the toxicological literature to determine the relative toxicity of potential contaminants (determine whether the species that is exhibiting toxicity is sensitive to potential contaminants and whether it is more sensitive to potential contaminants than species not exhibiting toxicity). This action also involves consideration of additivity or synergism of multiple toxicants.
- Work with an analytical laboratory. Frequently, samples contain compounds below recording limits or contain unknown peaks. Analytical laboratories can work to lower detection limits and identify unknown spikes. This step must be closely coordinated with TIE work.
- Consider factors besides contaminants. Salts, minerals, physical factors (high total suspended solids), and biological factors (pathogens) may be the source(s) of toxicity. Apparent toxicity may be due to a deficiency of a physiologically required element (for example, poor performance in soft water).

11.5.2 *Information Needed*

Work should begin immediately on determining the cause of toxicity exhibited by the following species:

1. *Ceriodaphnia* toxicity occurs throughout the Central Valley and Delta. Chronic toxicity has been detected over large geographic areas and over several months. The toxicity is detected during critical spawning times and locations. Ceriodaphnia chronic toxicity is commonly detected in water supplies and effluents that originated as groundwater. As we begin relying more on groundwater supplies, it is essential to determine why this water frequently causes chronic toxicity to *Ceriodaphnia.*

2. Striped bass toxicity tests conducted during the late 1980s and early 1990s indicated significant toxicity in the Sacramento River. Striped bass testing should resume during their spawning season, at all locations where eggs and larvae occur.

3. Rainbow trout embryo larval tests recently were initiated in the Sacramento River watershed. Acute mortality was observed at locations dominated by urban stormwater runoff. Testing should be resumed and should focus on critical habitats and critical periods for salmonid spawning.

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4. *Neomysis* has been used as a test species intermittently in the Sacramento River watershed, the Delta, and other fresh-water habitats characterized by high conductivity. *Neomysis* is an important food species for larval fish. Testing needs to be resumed.

5. The San Francisco Estuary RMP for Trace Substances (managed and administered by the San Francisco Estuary Institute) has detected significant amounts of toxicity in their RMP. Much of the toxicity appears to originate in tributaries to the Delta. Sediment toxicity is persistent. The San Francisco Estuary RMP efforts should be supplemented with sufficient resources to characterize the toxicity that has been detected.

Coordination with ongoing programs is essential. Multi-year monitoring programs should be developed for each condition listed above. The first year would focus on characterizing the toxicity spatially and temporally. The second year should focus on contaminant identification. The third year should focus on confirmation.

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It is critical that CALFED develop techniques and protocols for toxicity testing with indigenous species. This type of work already has been suggested to

CALFED by the Interagency Ecological Program Contaminant Effects Project Work Team and will not be repeated here.

This document does not focus on locations without toxicity information. Most of the toxicity testing conducted over the past 10 years has focused on the main stem rivers below the major reservoirs. It is critical that CALFED implement a more comprehensive monitoring program that includes critical habitats and the tributary watersheds to the Delta.

11.5.3 Existing Activities

Both the SFBRWQCB and the San Francisco Estuary Institute's RMP implement long-term toxicity monitoring programs to monitor toxicity in the Sacramento River, San Joaquin River, Delta, and San Francisco Bay. Recently, the Sacramento River Watershed Program began a toxicity monitoring program for the Sacramento River watershed. DeltaKeeper is about to initiate a monitoring program for the Delta. All CALFED CMARP actions should be coordinated with these existing programs.